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ABSTRACT

A study was conducted to refine a model Computer-Managed Information System (CMIS) that provides learning prescriptions based on students' learning styles and to identify specific problems concerning its implementation in other time-sharing environments. During the 1974-75 academic year, the CMIS that was constructed and tested the previous year at the University of Wisconsin-Stout was developed and refined. Visits with personnel in two vocational technical and adult education districts, and other contacts, revealed that considerable differences in computer software and stages of development of computer usage would restrict the implementation of the model. Efforts to promote the management of instruction based on learning styles should proceed according to the unique constraints at each computing environment and should include an initial emphasis on information storage and retrieval. The report includes objectives for an inservice course for teachers, a list of references, and a sample of the output from the system.
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Conducted by Allen Hilgendorf

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Center for Vocational, Technical and
Adult Education

University of Wisconsin-Stout

VT-103-274

A Study of the Transportability and Effectiveness of the UW-Stout CMIS and Individualized Instructional Systems Based Upon Learning Styles

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Acknowledgments

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Chapter I

Problem and Rationale

Summary

A computer managed information system (CMIS) that provides learning prescriptions based on students' learning styles was refined and problems concerning its possible implementation in other time-sharing computing environments were studied. The study, which included visits to two VTAE districts, revealed that considerable differences in computer software and stages of development of computer usage would restrict the implementation of the learning styles management model. Efforts to promote the management of instruction based on learning styles should proceed according to the unique constraints at each computing environment and include an initial emphasis on information storage and retrieval.

Problem

The specific problem for this project was the refinement and application of a computer managed information system (CMIS) in individualizing instruction based on students' learning styles. A model of a system developed under a sub-contract to Fox Valley Technical Institute (VTAE District 12) was to be refined, and problems concerning its implementation in various VTAE districts were to be identified.

Objectives

The objectives in this project were to:

1. Review the computer programs and information obtained from two different trial applications of a computer managed information

system to formulate a more generalized flow chart of the basic model.

2. Prepare a set of instructions along with appropriate system logic flow charts to aid instructors in adapting the CMIS model to their particular teaching environment.
3. Prepare detailed logic flow charts with sample program coding of those concepts which would be used in most applications of the CMIS model. Some of those concepts are as follows:
   (a) updating names or records in a file in alphabetical or numerical order.
   (b) calculating the degree of similarity between a set of learning styles and a specific learning activity.
   (c) ranking learning activities within groups according to degree of similarity with learning styles.
4. Identify instructors and administrators in three different VTAE schools who would agree to implement the CMIS model, and assist them with adapting the system to their particular educational and computing environments.
5. Record all hardware and/or logic related problems involved with implementing the CMIS in those three environments and use that information to improve the system portability.
6. Write a manual which includes the following major topics:
   (a) rationale for a learning styles based management system.
   (b) description of a system and how it can be adapted to the instructor's environment.
   (c) programming details concerning basic concepts used in the system.

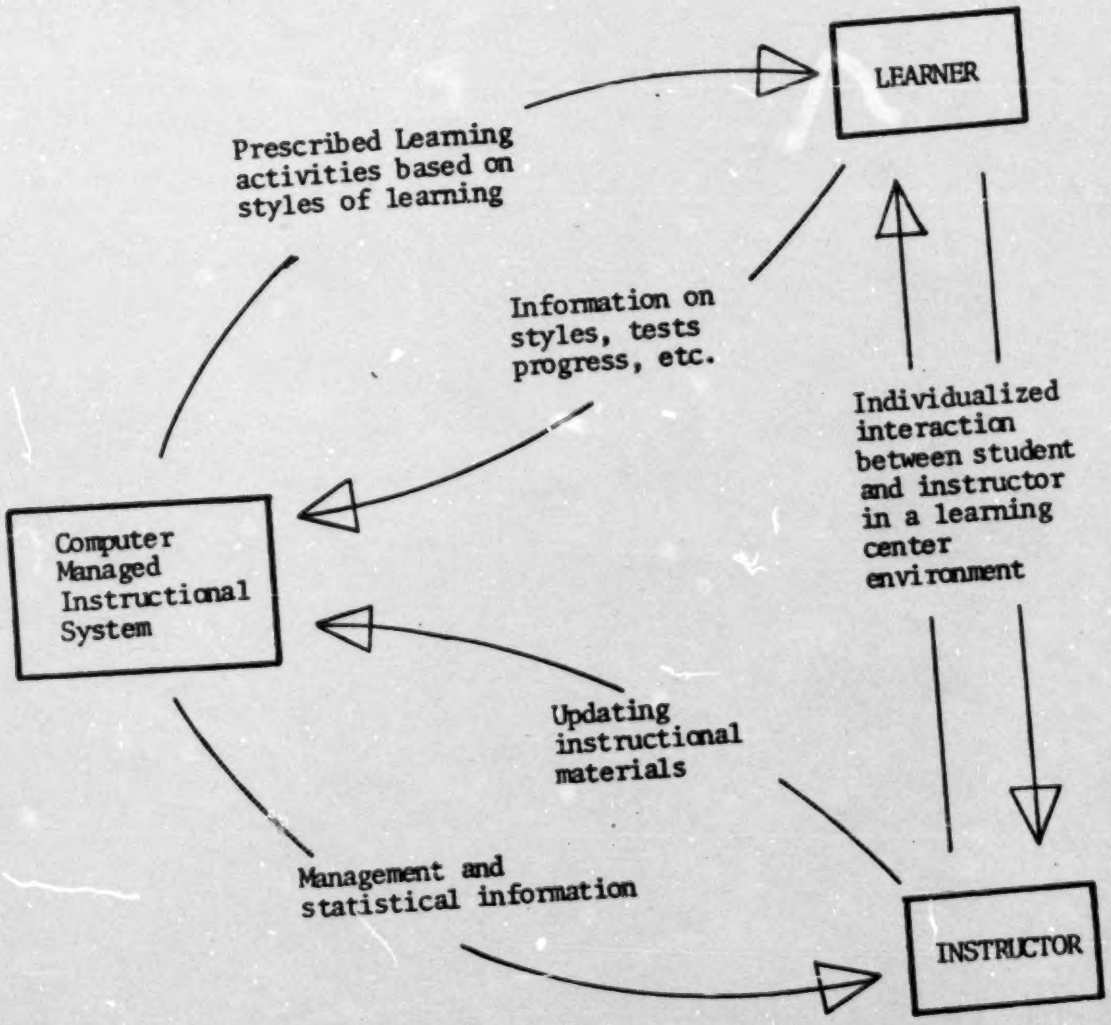
Rationale

Individualized instruction has long been recognized as the educational approach necessary to provide instruction for the many individual differences that exist among students. Although the need for providing individualized instruction has been recognized, some basic problems have been deterring its implementation. One of those problems involves handling the large amounts of information connected with managing a system in which each student may be at a different point in the course and require different materials.

Computerized systems are now available to help with all levels of this management task. By maintaining student records on a computer storage device and by continually monitoring a students' progress via on-line terminals, the teacher has access to daily progress reports. More sophisticated systems can provide a more detailed analysis of students' progress, suggested assignments and on-line evaluation. With the present availability of moderately priced time sharing equipment, the previously difficult bookkeeping problem involved in managing individualized instruction appears to be diminishing.

As the management of individualized, prescriptive instruction becomes feasible, another more fundamental problem concerning the criteria used to prescribe instruction must be considered. Learning style (a student's preferred mode of assimilating and processing new information) has been under investigation recently as a variable which tends to interact with various modes of instruction (Banks, 1973). As more evidence of this interaction becomes available, it appears that a computerized management system can be used (in fact will be necessary) to prescribe those learning activities which best match the learning styles of the learner.

A model of a computer managed information system (CMIS) which specifically includes the capability of prescribing learning activities based on students' learning styles has been developed at UW-Stout (Hilgendorf, 1974). Interaction of the learner, instructor and system components of that model can be depicted as follows:


LEARNER
Prescribed Learning activities based on styles of learning
Information on styles, tests progress, etc.
Individualized interaction between student and instructor in a learning center environment
Computer Managed Instructional System
Updating instructional materials
Management and statistical information
INSTRUCTOR

A primary function of the model is to store student related and instruction related information which can then be processed to provide learning prescriptions. The CMIS can input, store and output this information via on-line terminals located where and when the information is generated and needed. This means that the CMIS can perform many activities previously performed by teachers, thereby permitting teachers more time to interact with students.

Although preliminary applications of this learning styles based system at UW-Stout provided some information concerning its feasibility, specific problems concerning the actual implementation of such a system in other environments needed to be identified. Software for larger multi-program computer systems has always been difficult, if not impossible, to transport from one computing environment to another. Therefore, there is a need to construct a model which is documented well enough to enable teachers and programmers in new environments to construct a learning styles based management system for their unique hardware configurations which will satisfy their particular needs.

Chapter II

Methodology and Procedures

During the 1974-75 academic year this investigator continued to develop and refine the CMIS that was constructed and tested the previous year at UW-Stout. Also, articulation with personnel in two VTAE districts continued throughout the year to identify problems involved in implementing a learning styles based management system in new environments.

After analyzing the original CMIS and its use in a pilot application in the Industrial Physics department, it was decided to eliminate the pre-test component. The fact that students could immediately select a post-test on a module tended to make the pre-test a redundant and complicating feature. Work also continued on the on-line testing component of the CMIS.

To identify problems involved in implementing a learning styles based management system in new environments this investigator consulted with the following people:

(a) Fred Timm, instructor in Communication Skills
Fox Valley Technical Institute, Appleton, WI

(b) Lew Van Vliet, instructor in Electronics
Waukesha County Technical Institute, Waukesha, WI

Two visits were made by this investigator to each of the above mentioned schools to study their particular computing environments and discuss instructional management and other related uses of their computers. One visit was made by Mr. Van Vliet to UW-Stout to study instructional uses of computers.

In addition to the visits to FVTI and WCTI, several contacts were made by this investigator and Mr Van Vliet between UW-Stout and WCTI via computer terminals and telephone lines. Mr. Van Vliet dialed UW-Stout's computer using the terminal at WCTI to retrieve programs for use on their system while this investigator called WCTI to study problems involved in converting programs to run on their system.

The CMIS model was also tested during the Professional Growth Week - III at UW-Stout where information from participants and information concerning the various activities were stored and processed. A summary statement concerning each participant's learning styles along with his selected activities were available via on-line terminals. No attempt was made in that application to prescribe activities. (See Appendix A for Sample Output from PGW - III Management System).

Chapter III

Results

The major problems associated with implementing a learning styles based management system center around two factors. First, computing environments tend to differ widely in level of complexity and type. Second, an abstruse and more recently recognized problem is that an inherent evolutionary growth of computer activity within computing environments appears to exist and impede implementation of complete systems.

The differences among computing environments have always detered the transportation of systems. However, it was believed that a detailed model of the learning styles based management system could be reprogrammed for a unique computing environment more easily than creating a new system. Of the two time-sharing environments studied, this investigator concluded that the detailed model as it was designed could not be easily reprogrammed for either environment. However, the concept of prescribing instruction based on learning styles could be done at the Fox Valley Technical Institute via the higher level IBM-Coursewriter software.

Differences between the BASIC programming system on UW-Stout's PDP-11 and the IBM-Coursewriter system at Fox Valley are incomparable. The CMIS at UW-Stout consists of a set of BASIC programs operating on three major files containing student, module and testing information. The computer programs are then used by students and teachers to store and retrieve information from those files according to the instructions built into the programs. The Coursewriter system is a higher level programming language which accepts

both instructions and information from the instructor and creates programs containing the information along with instructions. Those programs are then used by students and can include as much or as little instruction (CAI) along with evaluation as the instructor directs. This major difference between the PDP-11, Extended BASIC, and IBM-Coursewriter timesharing systems implies that only the broad concept of instructional management based on learning styles is transportable.

The IBM timesharing system operating at Waukesha County Technical Institute (WCTI) is more similar to UW-Stout's system in that it uses the BASIC programming language. However, this investigator found it impossible to transport the CMIS programs to that system because of its limited file handling capabilities. The virtual array file capability of the PDP-11 was utilized in designing the CMIS system and, when one is limited to a sequential file manipulation as used on the IBM-BASIC, the handling of large amounts of data quickly becomes more difficult. The system at WCTI can be used for some components of the model such as record keeping and testing, but the flexibility necessary for providing learning prescriptions for a large number of students does not seem to exist.

Perhaps the most important factor detering the implementation of a complete system for instructional management lies not in the differences among environments but in an incremental growth of computer usage that exists at every institution. Gerald Lippey (1974) describes this inherent evolution in a book on computer assisted test construction. Lippey describes how teachers often start using the computer to perform simple activities dealing with the management or construction of tests. Later, as the teachers become more proficient in using the computer, they add record keeping. This incremental growth toward prescriptive systems, according to Lippey, will

more likely achieve widespread acceptance than a full grown system. He also feels that the benefits of incremental growth justify the cost.

This investigator observed this evolution at both sites he visited and feels that an attempt to bypass some of the stages of evolution described by Lippey would not be beneficial. Computer usage at Fox Valley Technical Institute now includes a sophisticated testing and CAI system. At Waukesha County Technical Institute the growth at this time centers around the use of BASIC programs for calculation and simulation.

This investigator made several attempts to write a manual or a set of instructions which could be used by teachers to implement a learning styles based CMIS. Each attempt became more difficult or frustrating because the instructions necessary for one application were too specific to be of any value for another application. Also, most teachers found the record keeping and testing components of the system more interesting and potentially useful than the prescriptive capabilities. Apparently, problems dealing with testing and record keeping are of more immediate concern to most classroom teachers.

After failing to write instructions as outlined in objective 6, this investigator turned toward identifying the steps in the incremental process described by Lippey. Those steps could then be used as a guide in writing the instructions to implement a CMIS. The steps are as follows:

(1) use of the computer to perform the rapid calculations necessary for simulating physical relationships.

(2) storage and retrieval of instructor generated information such as class rosters, instructional objectives, assignments, test items, etc.

(3) maintain records of students' progress in an individualized environment.

(4) manage and output repeatable tests using various random selection techniques.

(5) on-line testing.

(6) use of information from on-line testing to provide feedback in the form of CAI.

(7) use of pre-test and learning styles information to prescribe learning activities.

An analysis of the previously described activities in terms of what information is necessary for teachers to engage in those activities is summarized as follows:

Step #1:

This step is usually initiated by teachers who have had a basic programming course and/or who were active in promoting computers in technical courses.

Step #2:

This step requires information that has usually been associated with more advanced computer programming including manipulation of arrays.

Step #3, 4 and 5:

These steps require information generally associated with data processing where the updating and maintenance of data files are necessary.

Step #6:

This step involves techniques of formative testing.

Step #7:

This step requires knowledge about learning styles and how learning activities can be associated with particular learning styles.

It becomes obvious that instructions necessary to implement the CMIS model should include parts of courses in computer programming, data processing, computer science and education. Therefore, this investigator turned his attention to writing the behavioral objectives describing the competencies suggested in the previous steps. Those objectives describe the behaviors teachers exhibit in implementing a CMIS, and instructional materials tending to promote those behaviors will satisfy objective #6 of this project.

Chapter IV

Recommendations

After studying the feasibility of implementing a learning styles based management system at two different time-share computing environments, this investigator recommends that activities tending to promote the incremental growth described by Lippey be encouraged. Those activities would center around the storage and retrieval of information regularly used by teachers and students such as test items, class rosters, assignments, etc.

Teachers who have access to a computing environment utilizing a programming language similar to BASIC or FORTRAN and who are presently engaged in some computer activities may benefit from a course (in-service or other) emphasizing the storage and retrieval of information. Objectives of such a course have been written and grouped into five sequential modules as shown on the following pages. Many teachers are now using time-share terminals for calculation and simulation problems in their classes. It appears that some additional programming, conceptual skills in information storage and retrieval, and content analysis are necessary for the previously described evolutionary process to proceed toward prescriptive management systems.

Module #1

Introduction to CMIS

1. State three components of a computer managed instructional system that describe management functions which the system performs.

2. List two advantages a simple computerized record keeping system has over a manual method of maintaining class of course records.

3. Describe a method of generating tests with a computer to get large numbers of equivalent tests to be used for repeatable testing to predetermined levels of performance.

4. Compare on-line testing with various methods of off-line testing in the areas of feedback, individualization, time used for evaluation and security.

5. Identify two areas or operations of the instructional process in which the computer can perform prescriptively and describe the information needed for this function in both areas.

6. Reveal an interest in CMIS as evidenced by a desire to study subsequent modules.

Module #2

Structure of Management Systems

1. Construct a flow chart showing the sequence of major processes and activities in which a student engages in a self paced individualized learning environment. Specifically show on that flow chart the evaluation loop depicting repeatable testing to predetermined levels.

2. Given a brief description of the functions expected of a CMIS, list the kinds of information needed to perform those functions.

3. Given a list of various kinds of information related to the instructional process, group those pieces of information into logical files.

4. Given the names and contents of available files for a CMIS, identify which files would be utilized for a particular management or instructional process.

Module #3

Computer File Maintenance

1. Construct a flow chart and explain a logic of adding and deleting records which are stored in sequence in a random access file or array.

2. Construct a flow chart and explain a logic of adding and deleting records which are stored in sequence in a sequential file.

3. Describe two methods of looking up records in a sequential file and state which method would be most appropriate in a given computing environment.

4. Construct a flow chart and explain one method of ordering or ranking records within a file according to a particular variable.

5. Write and successfully execute a computer program in BASIC that will:

   (a) input a list of names into a file in random order.
   (b) alphabetize the file.
   (c) print out the list of names in alphabetical order.

Module #4

Testing and Grading

1. Given a performance objective dealing with the subject of computer managed instruction and a multiple choice test item, state whether or not the test item adequately tests the objective.

2. Describe three types of test items that can be used in a computer generated testing system.

3. Predict how many test items will be duplicated on subsequent off line computer generated tests when given the number of objectives, number of items to test each objective and the scheme for generating tests.

4. Given a scheme for computer generation of off line tests, construct a flow chart depicting the logic of that scheme.

5. List four kinds of information that can be used as feedback in an on-line testing system and discuss the advantages and disadvantages of using each kind of feedback.

Module #5

Learning Styles Based Prescriptions

1. List and briefly describe at least two learning styles that have been shown to interact with various learning activities.

2. Given a one dimensional array whose elements depict the level or presence of certain learning styles and another array whose elements depict the level of interaction of a particular learning activity with the corresponding learning styles, calculate an index which describes the degree to which the learning activity corresponds to the learning styles.

3. Describe how the similarity index as computed in objective 2 can be used to print out learning prescriptions.

References

Banks, John C. An Investigation of the Interaction of Learning Styles and Types of Learning Experiences in Vocational-Technical Education. Final report of a sub-project with Fox Valley Technical Institute. Menomonie, Wisconsin: UW-Stout; June, 1973.

Hilgendorf, Allen D. Investigating the Interaction of Learning Styles and Types of Learning Experiences and Assessment of Their Impact on Learning in Post-Secondary Vocational-Technical Education Programs: Phase II. Final report of a sub-project with Fox Valley Technical Institute. Menomonie, Wisconsin: UW-Stout; August, 1974.

Lippey, Gerald. Computer Assisted Test Construction. Educational Technology Publications, Inc., Englewood Cliffs, New Jersey, 1974.

Appendix A

Sample Output from PGW-III Management System

```
FOR INFORMATION - SELECT ONE OF THE FOLLOWING:
  1- LIST OF ALL QUEST TOPICS
  2- SUMMARY AND SCHEDULE FOR A PARTICULAR QUEST TOPIC
  3- QUEST TOPICS AVAILABLE FOR A PARTICULAR TIME
  4- PERSONAL INFORMATION


? 2
ENTER THE NUMBER OF THE QUEST TOPIC YOU WANT DESCRIBED:
? 15

WORK EVALUATION FACILITY TOUR:
     A TOUR OF THE UW-STOUT VOCATIONAL DEVELOPMENT CENTER
FACILITY LOCATED IN THE FARMERS' STORE BUILDING ON MAIN
STREET.  SUMMARY OF VOCATIONAL EVALUATION AND TRAINING
SERVICES INCLUDING WORK SAMPLES AND SIMULATED PRODUCTION.
A TOUR GUIDE WILL BE AT THE WORK EVALUATION CENTER TO
ACCOMPANY THE GROUP DURING THE SESSION.
PRESENTATIONS AT:
          TUE   4:30   IN ROOM FS
          WED   4:30   IN ROOM FS
          TH    8:15   IN ROOM FS
          TH    4:30   IN ROOM FS



FOR INFORMATION - SELECT ONE OF THE FOLLOWING:
  1- LIST OF ALL QUEST TOPICS
  2- SUMMARY AND SCHEDULE FOR A PARTICULAR QUEST TOPIC
  3- QUEST TOPICS AVAILABLE FOR A PARTICULAR TIME
  4- PERSONAL INFORMATION


?
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FOR INFORMATION - SELECT ONE OF THE FOLLOWING:
  1- LIST OF ALL QUEST TOPICS
  2- SUMMARY AND SCHEDULE FOR A PARTICULAR QUEST TOPIC
  3- QUEST TOPICS AVAILABLE FOR A PARTICULAR TIME
  4- PERSONAL INFORMATION

? 3
ENTER DAY AND HOUR OF INTEREST (INCLUDE COMMA)
  EXAMPLE:  WEDNESDAY, 2

? THUR,10
NBR          TIME          ROOM          TOPIC

 41    TH   10:00-11:00   AA-216   COOP TECHNIQUE AS A TEACHING METHOD
 42    TH   10:00-11:00   AA-210   COMPUTER APPLICATIONS (DEMOS)
 43    TH   10:00-11:00   AA-218   PROBS. WITH COMPETENCY BASED INSTRUCTION
 44    TH   10:00-11:00   AA-217   SIMULATION SKILLS
 45    TH   10:00-11:00   AA-220   BUZZ GROUP SKILLS
 46    TH   10:00-11:00   AA-221   TECHNIQUES FOR DEMONSTRATION


FOR INFORMATION - SELECT ONE OF THE FOLLOWING:
  1- LIST OF ALL QUEST TOPICS
  2- SUMMARY AND SCHEDULE FOR A PARTICULAR QUEST TOPIC
  3- QUEST TOPICS AVAILABLE FOR A PARTICULAR TIME
  4- PERSONAL INFORMATION

?
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FOR INFORMATION - SELECT ONE OF THE FOLLOWING:
  1- LIST OF ALL QUEST TOPICS
  2- SUMMARY AND SCHEDULE FOR A PARTICULAR QUEST TOPIC
  3- QUEST TOPICS AVAILABLE FOR A PARTICULAR TIME
  4- PERSONAL INFORMATION


? 4
ENTER YOUR LAST NAME

? Participant
     PARTICIPANT INFORMATION   * * * *   PGW-3   27-SEP-75

Participant                        DISTRICT:  NOTH CENTRAL TEC
  403  N. 10TH AVE                   STATUS:  REGULAR
  WAUSAU                              GROUP:  INSTRUCTIONAL IMPROVEMENT
  WIS    54401                     TEACHING:  ACADEMIC SUBJECTS
                                RECENT CREDITS:  3  4
                                LIVING IN DORM:  YES
                                FAMILY IN TOWN:  NO
     EDUCATION:  MASTERS DEGREE
     PGW PLANS:  INDIVIDUALIZING UNITS INCLUDING WORK RELATED ACTIVITIES
     LN STYLES:  SLIGHTLY CONCRETE AND SLIGHTLY UNSTRUCTURED
SELECTED QUEST TOPICS:
WED 10:00-11:00  RM AA-221    TODAY'S ADULT LEARNER
WED 11:00-12:00  RM AA-221    COMPETENCIES OF EDUCATORS OF ADULTS
TH   8:00- 9:00  RM AA-217    GAMING SKILLS
TH   9:00-10:00  RM AA-209    DISADVANTAGED ADULT LEARNERS
TH  10:00-11:00  RM AA-220    BUZZ GROUP SKILLS
TH  11:00-12:00  RM LIBRARY    INFORMATION ACCESS AND RETRIEVAL
TH   1:00- 2:00  RM AA-320    ERIC SLIDE TAPE PRESENTATION
TH   1:00- 2:00  RM AA-220    QUESTIONING SKILLS
TH   2:00- 3:00  RM AA-219    PROG. DEV. FOR ADULTS WITH SPL. NEEDS
TH   4:00- 5:00  RM AA-209    LEARNING STYLES - TEACHING STYLES


FOR INFORMATION - SELECT ONE OF THE FOLLOWING:
  1- LIST OF ALL QUEST TOPICS
  2- SUMMARY AND SCHEDULE FOR A PARTICULAR QUEST TOPIC
  3- QUEST TOPICS AVAILABLE FOR A PARTICULAR TIME
  4- PERSONAL INFORMATION

?
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